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The Fiftieth Annual Report

OF THE

UNIVERSITY OF MARYLAND

Agricultural Experiment Station



College Park, Prince George's County, Maryland

1936-1937

PUBLISHED BY THE STATION

The Fiftieth Annual Report
OF THE
UNIVERSITY OF MARYLAND
Agricultural Experiment Station.



College Park, Prince George's County, Maryland

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The University of Maryland Agricultural Experiment Station

The Board of Regents of the University of Maryland.

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H. C. BYRD, LL.D., College Park

STATION STAFF

Harry J. Patterson, D.Sc., Director

AGRICULTURAL ECONOMICS.

S. H. DeVault, Ph.D., Agr. Econ.
Paul Walker, M.S., Associate.
Ralph Russell, M.S., Assistant.
Arthur B. Hamilton, M.S., Assistant.

AGRICULTURAL ENGINEERING.

R. W. Carpenter, A.B., LL.B., Engineering.

AGRONOMY (CROPS AND SOILS).

†J. E. Metzger, B.S., A.M., Agronomist.
W. B. Kemp, Ph.D., Agron. (Genetics).
G. Eppley, M.S., Assoc. (Crops).
O. C. Bruce, M.S., Soil Technologist.
R. P. Thomas, Ph.D., Soil Technologist.
R. G. Rothgeb, Ph.D., Assoc. Plt. Breeding.
E. H. Schmidt, M.S., Assistant (Soils).
H. B. Winant, M.S., Assistant (Soils).
Geo. F. Madigan, M.S., Assistant (Soils).
R. L. Sellman, B.S., Assistant.

ANIMAL AND DAIRY HUSBANDRY.

K. C. Ikeler, M.S., Head of Department.
DeVoe Meade, Ph.D., Dairy and Animal
Husbandman.
B. E. Carmichael, M.S., Animal Husbandman.
L. W. Ingham, M.S. (Dairy Husbandry).
M. H. Berry, M.S., Associate Dairy
Husbandry.
Geo. Hughes, Dairy Mfg.
C. W. England, Ph.D., Assoc. (Dairy Mfg.).
Keith G. Acker, M.S., Asst. Animal
Husbandman.
C. M. Mechan, M.S., Asst. Dairy Insp.

ANIMAL PATHOLOGY AND BACTERIOLOGY.

R. C. Reed, Ph.B., D.V.M., Pathologist.
A. L. Black, Ph.D., Bacteriologist.
J. E. Faber, M.S., Asst. Bacteriologist.
M. T. Bartram, Ph.D., Assistant.

BOTANY, PATHOLOGY, PHYSIOLOGY.

††C. O. Appleman, Ph.D., Physiologist.
J. B. S. Norton, M.S., D.Sc., Pathologist.
C. E. Temple, M.S., Pathologist.
R. A. Jehle, Ph.D., Assoc. Pathologist.
Ronald Bamford, Ph.D., Assoc. Botanist.
Russell G. Brown, Ph.D., Asst. Physiologist.
Herman G. duBuy, Assistant Physiologist.

†Assistant Director.

††Dean of Graduate School.

The Station is located on the B. & O. R. R., City and Suburban Electric Car Line and the Baltimore-Washington Boulevard, eight miles north of Washington, D. C. Bell Telephone—Berwyn Exchange.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge to all residents of the State who request them.

ADDRESS:

AGRICULTURAL EXPERIMENT STATION,
COLLEGE PARK, MARYLAND.

ENTOMOLOGY.

E. N. Cory, Ph.D., Entomologist.
H. S. McConnell, M.S., Associate.
Geo. S. Langford, Ph.D., Associate.
L. P. Ditman, Ph.D., Assistant.
Geo. Abrams, M.S., Assistant (Bees).
C. Graham, M.S., Assistant.

HORTICULTURE.

A. L. Schrader, Ph.D., Act. Horticulturist.
T. H. White, M.S., Olericulturist and
Floriculturist.
S. W. Wentworth, B.S., Associate Pomologist.
F. B. Lincoln, Ph.D., Assoc. Plant Propagation.
H. B. Cordner, Ph.D., Associate Olericulturist.
W. A. Frazier, Ph.D., Assoc. Canning Crops.
Irvin C. Haut, Ph.D., Assoc. Pomologist.
J. B. Blandford, Asst. (Supt.).

LIVE STOCK SANITARY LABORATORY.

M. F. Welsh, B.S., D.V.M., State Veterinarian.
A. L. Brueckner, B.S., V.M.D., Pathologist.
L. J. Poelma, D.V.M., M.S., Assoc. Pathologist.
H. M. DeVolt, D.V.M., M.S., Assoc. Pathologist. (Poultry.)
C. L. Everson, D.V.M., Asst. Pathologist.
C. R. Davis, M.S., D.V.M., Asst. Pathologist. (Poultry).
Irwin Moulthorp, D.V.M., Asst. Pathologist. (Poultry).
W. R. Teeter, B.S., D.V.M., Asst. Pathologist.

POULTRY HUSBANDRY.

M. A. Jull, Ph.D., Poultry Husbandman.
R. H. Waite, B.S., Poultry Husbandman.
Geo. D. Quigley, B.S., Associate.

RIDGELY SUB-STATION.

Albert White, B.S., Superintendent.

SEED INSPECTION.

F. S. Holmes, M.S., Inspector.
Ellen Emack, Assistant Analyst.
Olive Kelk, Assistant Analyst.
Elizabeth Shank, Assistant.

UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION

Volume 50

1936-37

THE FIFTIETH ANNUAL REPORT OF THE MARYLAND AGRICULTURAL EXPERIMENT STATION

For The Fiscal Year Ending June 30, 1937

BY H. J. PATTERSON, Director

*To the Governor of Maryland, the Board of Regents, and the
President of the University of Maryland:*

In accordance with the provisions of the acts establishing and making appropriations for the Agricultural Experiment Station, there is presented herewith a statement as to its work and activities and a summary of some of its accomplishments, the titles of the publications issued, and a list of the projects in progress. The results given in these bulletins have been achieved because of the splendid cooperation obtained from the farmers of the State, and the fine working relations between the various individuals, divisions, and departments composing the teaching, extension and research staffs of the University.

From the results presented in the bulletins, and from evidences supplied by farmers, it is apparent that the Station is giving a handsome return on the money expended, and it would seem to be satisfactorily fulfilling the duties assigned to it. There is included the treasurer's financial statement showing the receipts and expenditures for the fiscal year. There are also appended copies of the thirteen bulletins published during the year.

CHANGES IN STAFF

During the year there have been one leave of absence; two resignations; and ten appointments. These are as follows:

Leave of Absence:

R. L. Sellman, Assistant Agronomist, has been granted one year's leave of absence.

Resignations:

H. L. Ayres, Dairy Manufacturing, effective December 1, 1936.

H. B. Cordner, Associate Olericulture, effective February 1, 1937.

Appointments:

M. A. Jull, Ph.D., Head of Poultry Husbandry Department.

K. C. Ikeler, M.S., Head of Animal and Dairy Husbandry Department.

L. H. James, Ph.D., Head of Bacteriology Department.

Russell G. Brown, Ph.D., Assistant Plant Physiologist.

Herman G. duBuy, Ph.D., Assistant Plant Physiologist.

Mark W. Woods, Ph.D., Assistant Plant Pathologist.

Albert Woods, M.S., Assistant Agronomy (Crops).

Roger F. Burdette, M.S., Assistant Agricultural Economy.

Stanley Stabler, B.S., Assistant Agronomy.

Geo. B. Hughes, Assistant Dairy Manufacturing.

Geo. J. Burkhardt, M.S., Assistant Agricultural Engineering.

RESEARCH FACILITIES

New problems and demands, and new methods of research make it necessary to provide new and additional facilities. The needs as outlined in the previous annual report have not changed though some of them are provided for in part by the appropriations for the next biennium.

PUBLICATIONS

During the year there have been thirteen bulletins published and distributed. These have consumed all the funds available for publications this year.

The members of the Station staff have contributed numerous papers to Scientific Societies and journals, the titles of which are listed below:

The following is a list of the bulletins and papers published:

Bulletin Number	Title	Author	Pages	Copies Issued
397	Economic Study of 99 Poultry Farms in Maryland	W. E. Hauver S. H. Devault A. B. Hamilton	1-35	3,000
398	Production and Feeding of Early Lambs	Wells E. Hunt	37-75	2,500
399	The Corn Earworm	L. P. Ditman E. N. Cory	77-90	2,500
400	The Vinegar Gnats or Pomace Flies	L. P. Ditman E. N. Cory A. R. Buddington	91-111	2,500
401	Manual for Milk and Cream testers	C. W. England	113-164	2,500

Bulletin Number	Title	Author	Pages	Copies Issued
402	Studies on Incubation Factors in the Agglutination Test for Pullorum Disease	H. M. DeVolt C. R. Davis	165-176	2,500
403	Strawberry Fertilizer Studies in Maryland	W. E. Whitehouse A. L. Schrader	177-206	2,500
404	Dairy Herd Organization and Income on Dairy Farms	DeVoe Meade	207-220	2,500
405	Economic Study of Dairy Farms in Maryland	S. H. Devault A. B. Hamilton	221-251	2,500
406	Economic Study of Livestock Farms in Maryland	W. E. Bell A. B. Hamilton S. H. Devault DeVoe Meade	253-298	2,500
407	Marketing Fruits and Vegetables by Motor Truck in Western Maryland	Ralph Russell R. W. Lennartson	299-375	2,500
408	Second Annual Report of the Dairy Inspection Service	C. W. England	377-387	2,000
409	Baltimore Wholesale Fruit and Vegetable Markets	R. F. Burdette S. H. DeVault		2,500

MIMEOGRAPHED REPORTS

The Consumption of Fluid Milk in Baltimore, Experiment Station Special Bulletin No. 4.	S. H. DeVault and A. B. Hamilton Ralph Russell
Membership of the American Farm Bureau Federation, 1926-35.	
Report of the Joint Tax Committee of the Maryland State Grange and the Maryland Farm Bureau, Incorporated, 1936-37.	W. P. Walker and S. H. DeVault
Report of the Highway Advisory Committee, 1937.	W. P. Walker, et al

PAPERS CONTRIBUTED TO SOCIETIES AND JOURNALS

- Anderson, E. J., and G. S. Langford. Insects and Diseases Commonly Encountered on Strawberries. Trans. Peninsular Hort. Soc. 26, 1936.
- Anderson, E. J., and H. S. McConnell. Spray Injury Investigations. Rept. Md. State Hort. Soc. 39:42-47, 1937.
- Appleman, C. O., and C. L. Smith. Effects of Previous Cold Storage on the Respiration of Vegetables at Higher Temperatures. Jour. Agri. Research 53:557-580, Oct 15, 1936.
- Bartlett, J. B., R. W. Ruble, and R. P. Thomas. The Influence of Hydrogen Peroxide Treatments on the Exchange Capacity of Maryland Soils. Proceedings of the Soil Science Society of America.
- Berry, M. H., and J. R. Manning. Comparison of the Feeding Value of Steam-Dried and Flame-Dried Menhaden Fishmeal. Jour. of Dairy Science, October, 1936, Vol. XIX, No. 10.
- Burdette, R. F. The Wholesale Fruit and Vegetable Markets of Baltimore City. Proc. of the Md. State Vegetable Growers' Assoc. December, 1936.
- Chandler, F. B. Absorption, Distribution, and Seasonal Movement of Potash in Young Apple Trees and the Effect of Potassium Fertilizer on Potassium and Nitrogen Content and Growth of Trees. Jour. Agr. Res. 53 (1):19-42, 1936.
- DeVault, S. H. The Philosophy Underlying a sound tax program. Proc. of the Sixty-Fourth Annual Session of the Md. State Grange, December, 1936.
- DeVault, S. H. Diversification in Agriculture. Southern Planter, May, 1937.
- duBuy, H. G. Chapter on "Physiology" in Manual of Pteridology. Edited by Fr. Verdoor, Den Haag, 1937.
- Frazier, W. A. Type and Severity of Cracking in Tomato Varieties. Proc. Amer. Soc. Hort. Sci. 34: p. 536, 1936. (Abstract only.)
- Frazier, W. A. Canning Crops in Maryland. The Canner, 82 (9): 7-8, 16, 1936.
- Frazier, W. A. Experimental Studies on the Cause of Cracking of Tomato Fruits. Trans. Penin. (Md.-Del.) Hort. Soc. 50:13-20, 1936.
- Greathouse, Glenn A., and Neil W. Stuart. Hydration Studies in Fresh and Dried Red Clover Roots and Shoots with Reference to the Physical Properties and Chemical Composition of the tissues. Plt. Phys. 11:4, 873-879, Oct., 1936.

- Greve, E. W. Effect of Shortening the Length of Day on Flower Bud Differentiation and on the Chemical Composition of Strawberry Plants Grown During the Normal Growing Season. *Proc. Amer. Soc. Hort. Sci.* 34:368-371. 1936.
- Haut, I. C., and A. Lee Schrader. Comparison of Root Development of Clonal and Seedling Understocks with Apple Varieties Under Orchard Conditions. *Proc. Amer. Soc. Hort. Sci.* 34:314-318. 1936.
- Lincoln, F. B. A Method of Appraising Apple Clonal Stock Material in the Nursery. *Proc. Amer. Soc. Hort. Sci.* 34:307-313. 1936.
- Lincoln, F. B., and L. P. McCann. Polyploidy in Native Species of *Malus*. *Proc. Amer. Soc. Hort. Sci.* 34: p. 26. 1936.
- Metzger, J. E. Fertilized Check Plots. *Proc. Soil Sci. Soc. of America*.
- Metzger, J. E. Soybeans in Maryland Rotations. *Rept. of the Md. Crop Improvement Assoc.*
- Metzger, J. E. Winter Barley. *The Southern Planter*.
- Metzger, J. E. Sweet Corn Fertilization. *The Southern Planter*.
- Rothgeb, R. G. Hybrid Corn (The Present Situation and the Result of Trials). *Rept. of the Md. Crop Improvement Association*.
- Russell, Ralph. Membership of the American Farm Bureau Federation, 1926-35. Reprinted from *Rural Sociology*, Vol. 2, No. 1. March, 1937.
- Schrader, A. Lee. Pruning Bearing Apple Trees. *Maryland Fruit Grower*, 6 (2) February, 1936.
- Schrader, A. Lee. Fall Applications of Fertilizers to Fruit Trees in Maryland. *Maryland Fruit Grower*, 6 (10), October, 1936.
- Schrader, A. L. Pruning peach trees to correct the errors of faulty pruning. *Proc. Md. State Hort. Soc.* 38:17-21. 1936.
- Schrader, A. Lee. Competition of Cover Crops with Young Apple Trees. *Maryland Fruit Grower*, 6 (5) May, 1936.
- Schrader, A. Lee. Trends in New Apple Varieties. *Maryland Fruit Grower*, 7 (2) February, 1937.
- Schrader, A. Lee. What Determines Color, Size, and Finish of Apples? *Maryland Fruit Grower*, 7 (5) April-May, 1937.
- Schrader, A. Lee. Detail pruning to assist in the production of better apples. *Proc. Md. State Hort. Soc.* 39:20-23. 1937.
- Schrader, A. Lee, and I. C. Haut. Spacing Studies on Several Strawberry Varieties with and Without Irrigation. *Proc. Amer. Soc. Hort. Sci.* 34:355-357. 1936.
- Stier, H. L. Delayed germination in the seeds of the potato. *Proc. Amer. Soc. Hort. Sci.* 34:433-35. 1936.
- Stier, H. L., and H. B. Cordner. Germination of seeds of the potato as affected by temperature. *Proc. Amer. Soc. Hort. Sci.* 34:430-433. 1936.
- Thomas, R. P., and J. E. Schueler. Potassium Retained in the Exchangeable Form By Some Maryland Soils. *J. A. S. A.*, Vol. 29, pp. 17-22.
- Thomas, R. P., and R. C. Williams. A Comparison of the Results of the Rapid Tests With the Amounts of Available Nutrients By Quantitative Methods. *Proc. of Soil Sci. Soc. of America*.
- Wentworth, S. W. Fruit and Foliage Injury. *Maryland Fruit Grower*, 6 (4) (5) April-May, 1936.
- Woods, M. W., and Ronald Bamford. Chromosome Morphology and Number in Tulipa. *Amer. Jour. Bot.* 24:175-184, April, 1937.

LIST OF ACTIVE PROJECTS, 1937-38

*Purnell

†Adams

**Bankhead-Jones

Agricultural Economics:

- *A-18 Organization and Business Analysis of Maryland Farms.
- *A-18-a Insurance and Credit Problems of Maryland Farmers.
- *A-18-f An Economic Study of the Broiler Industry.
- *A-18-g An Economic Analysis of the Baltimore Milk Market.
- *A-18-h An Economic Study and Analysis of Dairy Farms in the Philadelphia Milk Shed.
- *A-18-j An Economic Study of the Bee Industry in Maryland; Management, Production and Marketing Practices and Problems.
- *A-18-k An Economic Study of the Hatchery Industry in Maryland.
- *A-18-i An Economic Study of the Potato Enterprise in Garrett County.
- *A-18-m Types of Farming in Maryland.
- *A-19 The Farm Tax Problem in Maryland.
- *A-19-a Probable Economy and Increased Efficiency in Local County Government Through Redistricting of the State.
- *A-26 An Economic Analysis of the Present Status of the Marketing of Fruits and Vegetables by Motor Truck in New York City and Other Markets to Which Maryland Produce is Transported.
- *A-26-a An Economic Study and Analysis of the Baltimore Fruit and Vegetable Market.
- *A-29 The Status and Trends of Cooperative Marketing and Purchasing in Maryland, 1930-37.
- *A-31 The Marketing of Eggs in Maryland With Special Reference to the Baltimore Market.

Other Cooperative Projects:

Cooperative Project in Highway Planning.

A Study of Land Use Problems in Special Areas of Maryland.

A Study of the East Central Regional Agricultural Conservation Program and the Experimental Agricultural Conservation Program in Kent County, Maryland, and Surrounding Counties in the State in Relation to Agricultural Conservation and Adjustment With Special Reference to Formulation or Improvement of Production Under the Soil Conservation and Domestic Allotment Act; and a Study of the Relationships of the Resettlement Administration and the Agricultural Adjustment Administration Programs to the Promotion of Good Land Use in Kent County.

Agricultural Engineering:

R-3 Development of a Small Electric Pasteurizer.

R-4 Soil Sterilization.

R-5 Temperature Control in Electric Heated Hot Beds.

**R-6 Grain Storage on the Farm.

Agronomy—Crops:

B-38 Corn (Variety Tests, Selections).

B-39 Wheat (Varietal Tests, Environmental Studies, Plant Selections, Hybridization).

B-41 Barley (Hybridization and Selection for Winter Hardiness and Smooth Awns).

B-42 Hay, Forage and Pasture (Alfalfa strains, cutting dates; Grass Adaptation Studies; Red Clover Strain tests, and time of maturity studies).

B-43 Annual Legumes—Soybeans (Varietal and Type Selection Studies).

*B-44 Sweet Corn, Seed Production and Breeding.

B-45 Miscellaneous Projects (Dairy Rotation Studies).

*B-47 Studies on the Reproductive Capacity of the su (sugar) Factor in Relation to the Su (starch) Factor in Corn.

**B-49 Improvement of Permanent Pastures in the Several Soil Provinces of Maryland.

**B-50 Development of Dent Corn Hybrids Specifically Adapted to the Corn-Growing Areas of Maryland.

Agronomy—Soils:

†O-25 Effect of Organic Matter on the Fertility of Leonardtown Loam.

O-27 Field Studies of the Fertility Requirements and Management of Important Soil Types.

O-28 Fertilizer Studies with Potatoes and Sweet Potatoes.

*O-33 Efficiency of Soil Fertility Management.

*O-42 Effects of Fertilizer on Fertility and Grass Population of Pastures.

Relation of Organic Matter to Phosphorous Needs in the Soil. (Supplementary to O-33.)

Animal Husbandry:

*C-6 Study of Quality of Maryland Hams.

*C-10 Improvement of Thin Native Market Lambs and Lamb Meat by the Various Methods of Fattening.

C-13 The Breeding of Flock Ewes Suitable for Early Lamb Production.

Animal Pathology:

*D-28 Studies of Blackhead (Infectious Enterohepatitis) in Turkeys.

D-38-a A Study of the Urine of 100 (Brucella Abortus) Guinea Pigs at the Time of Death.

D-33-b A Study of the Feces of 100 (Brucella Abortus) Guinea Pigs at the Time of Death.

D-34-a The Examination of the Urine of Cattle for Brucella Abortus.

D-34-b The Examination of Feces of Cattle for Brucella Abortus.

D-35 Bovine Mastitis in Relation to Bang's Disease.

D-37 A Study of So-Called "Running Fits" in Dogs.

D-38 Studies on the Effects of Various Levels of Protein From Different Sources on the Internal Organs of Chicks.

D-39 Studies on Equine Encephalomyelitis.

Botany:

F-1 Botanical Survey of Maryland.

F-2 Identification of Plants and Diseases.

F-7 Chromosome Studies in the Genera Ipomoea, Gladiolus, and Tulipa.

**F-8 Plants Poisonous to Livestock.

**F-9 Cytogenetic Studies in the Genera Gladiolus, Tulipa and Ipomoea.

Dairy Husbandry:

G-3 Control of Contagious Abortion.

G-11 Growth Data of Dairy Animals.

G-15 The Effect of Feeding Kelp Meal upon Improving Breeding Efficiency of Dairy Cattle.

G-16 Input as Related to Output in Milk Production.

- G-17 Ingredient Analysis of Open Formula Live Stock and Dairy Rations Sold by the Grange League Federation and the Eastern States Farmers Exchange.
- G-18 Study to Determine to What Extent the Daily Production Records of Cows of the Station Herd Agree with Records Reported Under the Herd Test Plan.
- G-19 A Tracer for Use in Cream for Manufacturing Purposes.
- Entomology:
- †H-21 Biology and Control of Some Greenhouse Pests.
- †H-23 A Study of *Laspeyresia molesta* Busck in Maryland.
- *H-28 Methods for the Control of the Potato Tuber Moth.
- *H-29 Investigation and Biology of Insects Infesting Canning Crops.
- Subtitle: A. Biology and Control of Corn Earworm.
B. Biology and Control of the Mexican Bean Beetle.
C. Biology and Control of the Vinegar Gnat.
- †H-30 Apple Insects:
- Subtitle: A. Biology and Control of Apple Leafhoppers.
B. Biology and Control of the Plum Curculie.
C. Biology and Control of the Codling Moth.
D. Biology and Control of the Apple Aphids.
- H-34 Insecticidal Properties of Pyrethrum and Its Products.
- H-35 Nursery Insects.
- H-36 Insecticidal Investigations.
- Subtitle: A. The Chemical, Physical and Insecticidal Properties of Pine Tar Creosotes and Some Allied Products, etc.
B. Testing of New Insecticides and Commercial Materials Based Thereon.
- **H-39 Factors Involved in Spray Injury—Correlated with Insect and Disease Control and Physiological Effects.
- H-40 The Japanese Beetle: Its Life History and Control.
Tobacco Insects and Diseases.
- Floriculture:
- I-18 Sweet Peas. Varieties and Novelties.
- I-19 Breeding and Selection of Snapdragons.
- I-20 Gladiolus. Tests of Winter Blooming Varieties.
- Home Economics:
- *T-5 Methods of Cooking as a Factor in Palatability of Hams.
- T-6 Standards of Living of Maryland Farm Families.
- T-8 Factors Influencing the Palatability and Food Value of Eggs.
- Plant Pathology:
- J-50 Varieties of Plants Resistant to Diseases.
- J-60 Root-Rot of Peas.
- J-71 Apple Scab.
- *J-78 Strawberry Root Diseases.
- **J-80 Disease Resistance in Potatoes with Special Reference to Wilt and Vascular Discoloration.
- **J-81 Disease Resistance in Peas.
- Plant Physiology:
- †K-7 Physiological and Biochemical Aspects of Vegetable Storage.
- †K-17 A Physiological Study of the Resistance and Susceptibility of the Tomato Plant to Fusarium Wilt.
- †K-19 The Physiology of Cold Hardiness in Red Clover.
- †K-20 Nitrogen Metabolism in Plants and the Relation of This Metabolism to Important Plant Responses.
- †K-22 The Relation Between Vernalization and the Activity of Plant Growth Regulators, Flowering Substances, etc.
- †K-23 Time Rate of Oxygen Respiration in Some Cereals in Relation to Total Natural and Imbibed Water and to the Ratio of Free and Bound Water.
- Plant Propagation:
- *E-1 Vegetative Plant Propagation with Special Reference to Cuttings.
- Pomology:
- L-45 Fruit Spur and Biennial Bearing Studies with Apples.
- L-50 Sod vs. Tillage for Apple Orchards.
- L-54 The Influence of Pollination on Fruit Yields.
- L-55 Experiments in Grape Training and Pruning.
- L-57 Peach Pruning Experiments.
- L-58 The Breeding of Early Colored Grapes.
- L-59 Variety Tests of Apples, Peaches, Pears, Plums, and Cherries.
- L-60 Variety Tests of Grapes and Strawberries.
- L-61 Variety Tests of Bush Fruits.
- L-63 Collection of Phenological Data.
- L-64 Apple Breeding and Testing of New Seedlings.
- *L-65 An Economic Study of Peach Cling Stone Varieties for Canning.
- *L-66 An Economic Study of Peach Planting Distances.

- *L-67 A Study of Factors Influencing Color in Apples.
- *L-68 A Study of the Effect of Nitrogen and Other Fertilizers on the Firmness of Flesh, Shipping Quality, and Keeping Quality of Various Fruits.
- L-69 Studies of the Effects of Different Nitrogenous Fertilizers on Orchard Fruits.
- L-71 Removal of Spray Residues from Fruits and Vegetables.
- **L-72 Relations of Soil Moisture, Age of Plants, Size of Plants, Spacing of Plants, and Use of Mineral Nutrients to Flower Differentiation, Fruit Yield, and Quality of the Strawberry.
- **H-39 Factors Involved in Spray Injury—Correlated With Insect and Disease Control and Physiological Effects.

Poultry:

- M-28 Egg Laying Competition—(1) Studies of Seasonal Distribution of Egg Production as Influenced by (a) Rate of Production (b) Feed Rations. (2) Studies on Mineral Consumption.
- M-29 Tests of Special Methods for Drying and Pulverizing Poultry Manure as It Comes from the Dropping Boards.
- M-30 A Controlled Test to Determine the Efficiency of Approved Good Management in the Control of Bacillary White Diarrhea.
- M-31 Factors Influencing the Food Value of Eggs Both Fresh and in Storage.

Ridgely Farm:

- S-1 Growing Multiplication Plots of Mammoth Red Wheat for Distribution.
- S-2 The Use of Fertilizers in the Rotation of Corn, Wheat, Hay, and Tomatoes.
- S-3 Tests with Late Potatoes, New Varieties, and Seedlings.
- S-4 Variety and Fertilizer Tests of Strawberries.
- S-5 Experiments with Sweet Potatoes, Cantaloupes, Multiplication of Types.
- S-6 Experiments with Garden Peas for Canning.
- S-7 Tests of Varieties of Tomatoes and Early Plants on Total Yield.
- S-8 The Effect of Lime With and Without Fertilizers and Manure.
- S-9 Tests of Different Kinds of Lime on Alfalfa.
- S-10 Variety Tests of Corn, Wheat and Soybeans.
- S-11 Tests of New Selections of Wheat.

Seed Inspection:

- N-7 Inspection of Seeds Sold Throughout the State Each Year.
- N-8 Examination of Samples Taken from Seeds Sold Throughout the State Each Year.
- N-9 Examination of Samples Submitted to the Laboratory Each Year.
- N-10 Identification of Seeds Submitted to the Laboratory from Time to Time.
- N-11 Studies of Observed Variations Among Germination Tests.
- N-12 Studies of Changes in Weight of Various Components of Seed Samples.
- *N-13 Economic Use of Seeds.

Tobacco Investigations:

- P-1 Tobacco Breeding and Variety Tests.
- P-2 Crop Rotation Tests with Tobacco.
- P-3 Effects of Crops on Yields of Succeeding Crops in the Rotation with Special Reference to Tobacco.
- P-4 Fertilizer Tests and Studies in the Nutrition Requirements of the Tobacco Plant, with Reference to Both Quality and Yield of Leaf Tobacco.
- P-5 Improved Methods of Handling Seed Beds, Including Steam Sterilization.
- P-6 Nutritional Deficiency Studies.

Vegetable Gardening:

- *Q-58 Factors Influencing the Yield and Quality of Garden and Canning Peas.
- Q-59 Rhubarb—Factors Affecting Growth of Rhubarb.
- Q-60 Cantaloupes—Breeding and Selection.
- Q-61-c Sweet Potatoes—Cultural Practices Affecting Production.
- Q-61-d General Fertilizer Problems—Maintaining the Fertility of Land for Garden Crops.
- Q-63 Testing New Varieties and Strains of Vegetables.
- Q-65 Planting Distances and Different Formulas of Fertilizers for Asparagus.
- Q-67-a Tomatoes—Breeding and Selection of Varieties for Canning.
- Q-67-b Tomatoes—The Influence of Green Manures Supplemented by Commercial Fertilizers in Tomato Production.
- Q-68-b Breeding and Selection of a Fruitful Type of Lima Beans for Maryland.
- Q-71 Potato Breeding and Inheritance.
- Q-72 A Study of Factors Affecting Development of Red Color and Quality of Canned and Raw Stock Tomatoes.
- Q-74 A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland.

PROJECTS CARRIED ON BY GRADUATE STUDENTS

Agronomy:

- Rapid Soil Testing, Lex B. Golden.
- A Comparison of Chemical Composition and Seasonal Distribution of Growth Among Strains of Kentucky Bluegrass, Alfred D. Hoadley.
- Chemical Study of the Changes and Formations in the Leonardtown Hardpan, G. F. Madigan.

PROGRESS OF RESEARCH

The statements regarding the research work have been presented by the different departments.

The reports have been prepared either by the head of the department or a member of the department designated by the head.

AGRICULTURAL ECONOMICS

S. H. DEVAULT

Work was conducted during the year on fourteen Experiment Station projects and on three cooperative projects with Federal and State agencies. Some of the accomplishments and significant contributions are listed below.

FARM ORGANIZATION AND MANAGEMENT

Livestock Farms:

The two-year study of livestock farms was completed and the results were published in Bulletin No. 406. The report covers investment, receipts, expenses, farm income, labor income and factors influencing profits on farms specializing in the production of livestock; the bulletin also indicates the relative importance of each class of livestock from the standpoint of income of the farmer. The area surveyed covers five counties of the State. All of the farms studied are in the Piedmont Plateau region, which is a good farming region.

The average size of farms was 267 acres, 47.9 per cent of which was in crops and 36.5 per cent in pasture. The crops in the order of their acreage were wheat, hay, and corn.

The average number of each kind of livestock per farm was: steers, 25.9; hogs, 24.6; and sheep, 25.6 head.

The average investment was \$23,336, of which 76.3 per cent was in real estate. Farm receipts averaged \$3,846 and farm expenses, \$2,700, leaving an average farm income of \$1,146. Interest on investment amounted to \$1,167, leaving a labor income of —\$21.

Dairy Farms:

The three-year study of dairy farms in the Piedmont Plateau area was completed and the results of this study were published in Bulletin No. 405.

This study shows the investment per farm, farm expenses, farm receipts, farm income, labor income, size of herds, milk production per cow, cost of producing milk, factors influencing profits, and a comparison of the profitable and unprofitable dairy farms.

Records have also been obtained, for one year, on 128 dairy farms in the Upper Eastern Shore area.

Specialized Broiler Farms:

An economic study was made of farms specializing in broiler production for the two-year period beginning July 1, 1934 and ending June 30, 1936.

Broiler production in Maryland for the year 1936 was approximately 2,500,000 birds, or about 15 per cent of the estimated United States production for the year 1934-35.

The following are some of the significant figures: Average investment per farm, \$1,295; income, \$4,645 per farm, or 54.7 cents per bird; cost per bird, 49 cents; and net profit per bird, 5.7 cents. Feed was the most important item of cost, amounting to 51.2 per cent of the total cost. Cost of chicks was second in importance, and amounted to 23.8 per cent of the total cost. The study analyzes fifteen factors that were important in influencing farm profits.

Poultry Farms:

The purpose of this study, which was conducted over a three-year period, was to establish facts concerning the organization, management and profitableness of poultry farming in the State and to determine the causes of variation in profitableness. The results of this study were published in Bulletin No. 397, in July, 1936.

The following are the significant data on a per farm basis: Number of layers, 781; eggs per hen, 127; investment per farm, \$8,829; farm receipts, \$3,524; farm expenses, \$2,353; farm income \$1,171; labor income, \$728; cost of producing a dozen eggs 20.1 cents; and average selling price per dozen 21.9 cents. The most profitable and least profitable farms are compared on the basis of the factors that influenced profits.

An Economic Study of the Bee Industry:

The objectives of this study are: (1) To determine the present status of apiaries in Maryland; (2) to determine the possibilities of honey production as a supplementary source of income; (3) to determine the organization of apiaries and the practices followed in the production of honey; (4) to isolate the factors that determine the efficiency of production and to evaluate the relative importance of these factors in influencing income; and (5) to secure information on marketing practices, methods of sale, and prices.

Over 30 records have been secured from bee keepers and a survey has been made of the consumption, uses and retail outlets for honey.

Types of Farming:

This is a joint project of this Experiment Station and the Division of Farm Management and Costs of the Federal Bureau of Agricultural Economics.

The objectives of this study are: (1) To portray in a general way the agriculture of the State by showing the kind and proportion of crops and livestock produced; (2) to delineate areas within which certain combinations of crops and livestock predominate; and (3) to show how the predominant types of farm organization in each area are related to the conditions existing in the area.

Farm Organization and Soil Management Practices in Relation to Agricultural Conservation and Adjustment:

This project was inaugurated in July, 1936, the Experiment Station cooperating with the Agricultural Adjustment Administration and the Soil Conservation Service. The study was conducted in the dairy, tobacco and truck-farming areas of the State to determine the land use adjustments necessary to maintain erosion control.

Land Use Planning:

The Experiment Station is cooperating with the Resettlement Administration in this project in land use planning in Maryland. At the present time two sub-projects are being carried on, as follows: (1) A land use study in Southern Maryland; and (2) a study of the economic and social status of farm people in the Mountain Area and the possibilities for their improvement.

MARKETING

Fruits and Vegetables:

A. During the year one phase of the project on the marketing of fruits and vegetables was completed. This particular study dealt with the status of the marketing of fruits and vegetables by motor truck. The results were published in Bulletin No. 407.

Records covering the tonnage and value of produce, types of buyers and selling agents, and marketing costs were obtained for several hundred truckers in the Washington County area and the areas near Baltimore and Washington, D. C. Another bulletin will be issued soon covering the costs of operating trucks.

B. The study of the farmers wholesale fruit and vegetable market in Baltimore was completed during the year. Some of the significant facts in this study are: The total receipts on the Marsh Market were approximately \$3,300,000 in 1934, and the volume was about 140,000 tons; about one-fourth of the produce came from without the State and about three-fourths came

from Maryland producers; 85 per cent of the produce was sold to Baltimore dealers and 15 per cent was sold to buyers outside the State; of the local sales, 45.73 per cent went to jobbers, 48.21 per cent to canners, and the remainder to retailers, peddlers, hucksters, etc.; the study further indicates that the facilities in this market are inadequate to handle the volume of business during at least seven months of the year.

C. A study was inaugurated early in 1936, covering the railroad terminals, boat wharves, wholesale markets, jobbing markets, chain stores and public retail markets handling fruits and vegetables in Baltimore.

The purpose of this study was to obtain information about the origin of receipts of fruits and vegetables in the different markets, the channels and cost of distribution, marketing facilities, congestion of the different markets and to suggest a plan or plans for reorganizing the markets in such a way as to facilitate the movement of produce and reduce the cost of marketing. The results of this study will be found in Bulletin 409.

Cooperative Egg Auctions:

A study entitled, "Some Basic Factors Pertinent to the Establishment, Organization and Operation of Production Point Cooperative Egg Auctions in Maryland" was inaugurated in July, 1936. The study covered the seasonal production of eggs in the principal producing areas in the State, the seasonal marketing of eggs, methods of sale, principal markets in which the eggs were sold, methods of transportation, marketing cost, prices received, and general information in regard to local production, consumption and purchase of eggs.

The surplus of eggs produced in the Lower Eastern Shore counties was 5,287,469 dozens for the year 1935; in four counties in the Piedmont Plateau region, the surplus of eggs above the consumptive requirements in the counties was 6,542,173 dozens.

In the Western Shore region, 30.7 per cent of the eggs were sold through wholesale merchants; 29.3 per cent to hucksters; 19.8 per cent direct to consumers; 14.9 per cent to retail merchants; 1.8 per cent to hotels; 1.5 per cent to local stores; 1.2 per cent to hatcheries; and .8 per cent through commission merchants.

In the Eastern Shore area, 56.4 per cent of the eggs were sold through wholesale merchants; 27.9 per cent to hucksters; 7.6 per cent to hatcheries; 5.7 per cent through commission merchants; 1.7 per cent to retailers; .4 per cent to hotels; .2 per cent to local stores; and .1 per cent direct to consumers.

In the Eastern Shore area, 70 per cent of the eggs went to the New York market; 11.7 per cent to the Philadelphia market;

10 per cent were sold locally; and the remainder were sold to markets in New Jersey, none being reported as going to the Baltimore market.

The information obtained in this study indicates that production egg auctions might be successful if located near Westminster and Denton.

Status and Trends of Cooperative Marketing and Purchasing, 1930-1937.

This project was inaugurated in July, 1936. Through interviews with the managers, directors and representative growers of the associations information is being assembled on the volume of business done by the cooperatives, commodities handled, membership, financial status, sources of loans and debt obligations, sales policies, etc.

This is a two-year study and it will be continued during the fiscal year 1937-38.

Consumption of Fluid Milk in Baltimore:

In March, 1937, 12,400 schedules were mailed to residents of Baltimore City. The city was zoned into 72 districts. The schedules returned numbered 2,439, or 19.7 per cent of the number mailed.

The average per capita consumption of milk in Baltimore was found to be .748 of a pint daily. Of the families reporting, 24.4 per cent said that they were using more milk than a year ago and 19.5 per cent reported that they were using less milk than a year ago. The principal reasons for using more milk were reported as follows: Better understanding of food value, more ways to use milk in cooking, larger family, more use of flavored drinks, doctor's orders, and larger income. The reasons given for using less milk were as follows: Smaller incomes, smaller family, economizing, fattening and doctor's orders.

FARM TAXATION AND FINANCE

Study of Local Governments:

The information in this study was collected in the fiscal year 1935-36 and some of the accomplishments were published in the Forty-Ninth Annual Report.

The counties in Maryland have an assessed wealth of \$999,000,000, as a basis for taxation. This wealth varies in its distribution among the counties from \$212,589,000 in Baltimore County to \$5,787,000 in Calvert County. Tax levies in the several counties vary from \$2,317,401 in Baltimore County to \$80,493 in Calvert County.

If the counties in Maryland were consolidated into six or seven districts, it is estimated that a very material saving might be made.

The results of this study are available in manuscript form and will be published during the year 1937.

Tax Problems in Maryland Counties:

Studies are being made in several counties for the purpose of determining advisable changes in the fiscal affairs of the counties. These studies include farm property assessments, inequality of assessments, comparative tax burden for specific county services, and factors contributing to high tax rates and possibility of reducing same.

Highway Planning:

The Department of Agricultural Economics is supervising the financial aspect of a State highway planning survey conducted jointly by the Maryland State Roads Commission and the United States Bureau of Public Roads. Data are being collected on three major phases related to the financing of highways, namely: (1) A comparison of highway tax contribution and highway usage on the part of different economic groups within the state; (2) tax levying and distribution of highway funds by the state and political sub-divisions; and (3) life expectancy of different kinds of road pavements and relative cost of maintaining same.

Highway Advisory Committee:

The Department of Agricultural Economics was represented on the Governor's "Highway Advisory Committee." The Committee submitted its report to the Governor in February, 1937.

The Committee pointed out three major highway problems that confront the State of Maryland, as follows: (1) Rehabilitation, reconstruction, modification and improvement of the existing state mileage; (2) additions to the arterial system, especially in providing for through and local traffic in heavily congested areas; (3) improvements of local roads of counties, and roads and streets of incorporated places, so that such roads and streets will serve as feeder roads to the main arterial system as well as adequately serve the local communities.

The committee suggested six corrective measures preliminary to the final accomplishment of a complete highway plan.

ACCOMPLISHMENTS OF THE RESEARCH PROGRAM OF THE DEPARTMENT OF AGRICULTURAL ECONOMICS

The Department of Agricultural Economics was established in 1922. It was not until 1925 that funds were made available

in the Maryland Agricultural Experiment Station for the making of economic research studies. Such studies as were made in economic research prior to this time were conducted under the auspices of the Extension Service.

The projects in Agricultural Economics are of short-time duration, and cover such a variety of topics, that it would be exceedingly difficult to summarize the results of these studies. Instead, the projects have been grouped by subject matter, and the projects completed and in progress listed.

The following is a list of the research projects completed and those now in progress, grouped according to subject matter.

MARKETING

Projects Completed

1. Marketing of Wheat in Maryland. Extension Bulletin No. 30, December, 1923, by S. H. DeVault.
2. Marketing of Fruits and Vegetables With Special Reference to the Baltimore Market. Typewritten report, 23 pages, 1923, by S. H. DeVault.
3. Roadside Markets in Maryland. Experiment Station Bulletin No. 280, 1926, by S. H. DeVault and G. E. Bouis.
4. Manufacture and Distribution of Tomatoes, Sweet Corn and Peas in Maryland. Experiment Station Bulletin No. 301, 1928, by W. J. Hart.
5. The Marketing of Livestock in Maryland With Particular Reference to the Baltimore Market. Manuscript prepared by B. B. Powell, 1928.
6. Economics of the Peach Industry in Maryland. Mimeographed report, 1929, by W. P. Walker.
7. Membership Study of Cooperative Marketing in the Potato District of the Eastern Shore of Maryland and Virginia. Experiment Station Bulletin No. 1929, by T. B. Manny.
8. Prices Paid for Maryland Farm Products, 1851-1927. Experiment Station Bulletin No. 321, 1930, By Roger F. Hale.
9. The Wheat Industry in Maryland. Typewritten Report, 1931, by S. H. DeVault.
10. A Study of Local Cooperative Associations in Maryland. Mimeographed Report, 1932, by Paul Nystrom.
11. Consumer Preference and Market Demand for Eggs in Washington, D. C. Typewritten Report, 1932, by Paul Raper.
12. The Milk Price Situation. Mimeographed report, 1933, by S. H. DeVault and Ray Hurley.
13. Roadside Markets in Maryland. Experiment Station Bulletin No. 365, 1934, by S. H. DeVault and Roger Burdette.
14. Marketing of Fruits and Vegetables by Motor Truck in Western Maryland. Experiment Station Bulletin No. 407, 1936, by Ralph Russell and R. W. Lennartson.
15. Consumption of Fluid Milk in Baltimore. Experiment Station Special Bulletin No. 4, 1937, by A. B. Hamilton and S. H. DeVault.
16. An Economic Study and Analysis of the Baltimore Wholesale Fruit and Vegetable Markets. Experiment Station Bulletin No. 409, 1937, by S. H. DeVault and Roger Burdette.

AGRICULTURAL ENGINEERING

R. W. CARPENTER

1. Mr. George J. Burkhardt joined the staff of the Experiment Station on June 1, 1937. Prior to that time, the Department of Agricultural Engineering, for several years, had no personnel assigned to research work.

The project in "Grain Storage on the Farm," R-6, a joint project with the U. S. Department of Agriculture, was carried on with the Experiment Station furnishing only non-technical assistance for the storage season of 1936.

All wheat placed in the experiment bins had a moisture content of 16.4 and 16.5 per cent. Summing up briefly the results, it is revealed, First, that wheat harvested and threshed with a moisture content of 16 per cent or more cannot be safely stored in any known form or type of bin, without first being treated. Second, that bin insolation retarded heating but did not prevent spoiling of wheat containing 16.5 per cent moisture. Third, that ventilation is of value in the retarding of heating by permitting greater heat dissipation, and in removing moisture, though once the wheat has gone out of condition ventilation loses value rapidly. Fourth, that use of absorptives as a drying agent has considerable promise, but their practical application is yet to be proved. The value and dangers of chemicals should be further investigated.

Another substance which is of particular interest, although its form of action is unknown, is a lime-sulphur mixture. Its use was discovered in one of the farm bins. The results are unaccountable. The farm bin containing a small amount of this mixture in wheat with an initial moisture of 16.4 per cent dried down to 13.4 per cent without any known evidence of heating or going out of condition. All of our experimental bins having similar moisture content heated and went out of condition. These results are so unusual and unaccountable that they warrant further study.

These tests have been helpful in determining maximum limits of moisture content for safe storage of wheat, for the improvement of experimental technic, and in suggesting new and promising lines of research.

2. The only active project at present is the cooperative project in grain storage. All preparations have been made to carry this through another year on a considerably expanded basis.

Projects R-3, R-4 and R-5 all involve special applications of electrical techniques, and should be considered dormant at present.

3. A project is contemplated for the fall and winter of 1937-38 dealing with the problems of the control of temperature, humidity and air movement in tobacco curing barns.

4. Very little research work has been done in this department since its organization, due to lack of personnel. A project on the development of an electrically heated sterilizer for dairy equipment was completed and the results have been used by a Maryland company as the basis for the design and manufacture of commercial equipment. Much available information has been secured relating to the use of electricity in (1), heating soil for hot beds, (2), sterilization of soil, and (3), pasteurization of milk.

DEPARTMENT OF AGRONOMY

J. E. METZGER

The passage of the Hatch Act (1887) and the establishment of the State Experiment Stations preceded the formation of subject matter departments by at least a decade. Although work of an agronomic nature has been in progress continually since the organization of the Station, it was not developed as a distinct branch of inquiry until 1904.

The lines of work as organized during the intervening year may be grouped as crop production, crop improvement, breeding and selection, soil classification, management and fertility.

CROP PRODUCTION

The research work in crop production has been centered mainly around methods, the response of the field crops to environment, and the adaptability of varieties and strains to Maryland conditions. The work in methods of production early led into crop combination and rotation studies, a type of investigation in which new problems are constantly developing. Data have been collected for a large number of types of crop combinations and at present a new type of dairy cropping system is being investigated. From the standpoint of environment both cereal and forage crop studies have been made. The most extensive of these is the study of the response of wheat to environmental factors (Bulletin 297). In the variety tests more than two hundred strains and kinds of wheat have been tried. Several of the wheat varieties have been in the tests for more than forty years.

In the field of forage, greatest attention has been given to legumes. The first work in alfalfa is its adaptability to the climate. This work was started in 1890. Between 1907 and 1917 an extensive study of the adaptability of the crop to var

ous soils was made. This record of the response of alfalfa was made on 1,548 fields. In more recent years work has been done on the determination of the adaptability of alfalfa from seed of various sources and on the management of the crop; the latter especially when grown in combination with other forage plants, and also with reference to maturity at harvest time.

Several hundred varieties of soybeans have been tested for hay and oil production, since 1888 when the first tests were made. The Virginia, a brown bean, and the Wilson-Five, a black bean, have proven best for hay purposes, and Haberlandt is probably the best for oil when a wide range of cropping conditions is considered. A new test series of soybeans for manufacture purposes is being conducted now in addition to the forage studies. Work similar to the soybean studies was begun with cow peas in 1888. The crop requires much hand work for seed production, and is not as widely grown as soybeans. No Station work has been done on this crop since 1923.

The studies on clover have included red clover, alsike, crimson, and the sweet clovers. These crops have been studied from the standpoint of hay, soil improvement, and pastures. With red clover, the source of seed and the resistance to anthracnose have been the main problems. The chief interest in alsike has been in its wide adaptation to soil conditions and its favorable combination with alfalfa. Sweet clover has found greatest favor as a pasture crop, and for soil improvement.

In more recent years, work has been done on the grasses in the study of their relative importance as turf and pasture producers on various soil types. This work has led to the study of extending the lush pasture period by use of various species of grass, and also to a study of strains of pasture grasses that may have a wider adaptability in Maryland than crops produced from the usual commercial seed lots. The report on the state-wide survey of the permanent pastures of Maryland made in 1935 (Bulletin 373) has had a very favorable demand. A total of thirteen forage crop bulletins has been published since 1902.

CROP IMPROVEMENT

It has long been recognized that variability may be induced by hybridization, or it may be moderated by inbreeding. In close pollinated plants the method pursued has been hybridization between varieties and strains. At the Maryland station considerable attention has been given to the development of disease-resistant strains of wheat. Perhaps the greatest contribution in this respect has been the environmental studies that have been made from the long time tests. These studies have led to the discovery that the disease factor determines the quality of the

crop and that air drainage and sunshine are the most outstanding factors in its control, also that the bearded varieties of the Fulcaster response type are more resistant than the smooth varieties, to the wheat scab known as Septoria. Several wheat hybrids have become important commercially.

The development and use of winter barley which first came into the state about twenty years ago has been greatly retarded by the physical characteristics of the plant. The seed head of the barley plant is very brittle. The hooded types when grown shatter excessively, and all of them that have been tried in Maryland tests were found to have weak straw. On account of the resistance to the rough-awned barleys, both from the standpoint of handling the crop and feeding it to animals, a concerted effort was made in 1926 to secure a smooth-awned type. The result of this work is a new hybrid barley having winter characters and smooth beards. The new hybrid seems to have relatively wide adaptation and promises to be effective in increasing the acreage by at least threefold. The production of winter barley is an extremely important economic factor in Maryland agriculture. Its production to full capacity should be the means of reducing expenditures for feed grains by at least four million dollars annually. The hybrid barley will be the means of effecting this great saving.

The system of making individual selections, especially in close pollinated species, has been in progress at the Maryland Station since about 1905. In the intervening years, thousands of selections have been made, and it is safe to say that the entire acreage of wheat, oats, barley, and perhaps to a large extent, rye, is now grown from seed that had its origin under this method of plant improvement. In recent years it has been found desirable to use this method for strain and variety purification. Hence, each year there is planted in the nursery plots some selections made especially for this purpose.

The question of amount of work done on small grains at the Maryland Station has been raised many times. The extensive work is justified on the basis that in the Maryland system of agriculture it is highly important that the soil be kept covered in the winter time due to the fact that snow coverage is not extensive or reliable. Winter grain crops thus become an important means of soil conservation and as such no amount of work that can be done without neglecting other work will be wasted effort, or improvident.

SOIL CLASSIFICATION

"On the basis of studies made while connected with the Maryland Agricultural Experiment Station, Professor Milton Whitney

came to the conclusion that the adaptability to soil of a given crop, and the success with which a crop could be grown on any given soil, was dependent primarily, if not exclusively, on its texture."* Professor Whitney did his preliminary work from 1890 to 1899. The first county to be surveyed in the United States was Cecil County, Maryland, in the summer of 1899. The first surveys and classifications were based largely upon the derived soils of certain geologic formations. It has been learned since then that the rock materials undergo great changes and that other characters must be taken into account in soil classification. For this reason most of the early surveys were found to be out of harmony with the more or less standard system of classification. All of these counties have been resurveyed, and the maps for all of the counties are now in accord with the generally accepted nomenclature used in soil classification. The reports on the soil surveys constitute the most useful single factor in the effort to understand the nature and distribution of this complex material, and its adaptation to agricultural pursuits.

SOIL MANAGEMENT AND FERTILITY

Growth and development in soil management and fertility studies have been gradual but positive. In many avenues in this field the need for certain elements and the positive benefits derived from their use had been known long before any adequate explanation could be given for the phenomena. For example, the use of lime and the recognized benefits in its use preceded the discovery by many years, the current thought that liming is largely a matter of replacing depleted bases in soils. The harmful effects of a low supply of bases in the exchange complex of the soil is entirely a matter of recent work. The early soil fertility activities had to do mainly with field plot work. Field plot work has been conducted in recent years also, but in almost every instance the project has had a larger laboratory program than field program. The combined field and laboratory attack on soil fertility problems is more promising of far-reaching results than any plan yet used by the Department. A notable change in field work has been that pertaining to size of plots, and number of replications. The early plots were large and never occurred in more than duplicate plots. In recent years the plots are much smaller but are planted in greater number of replications, the triplicate system being the minimum. Within the last five years the system of treated check plots has superseded the old system of using untreated check plots. The advan-

*Atlas of American Agriculture.

tages of this system are set forth in the report published in the Proceedings of the Soil Science Society of America, Volume I.

Field plot work at the Maryland Station has not been limited to the local landholdings. Much of the work of the last twenty-five years has been conducted at selected locations throughout the State. All of the important soil series have been used in work of this kind. At present, field plot work is being maintained on leased land at five different points in the State, and by cooperate arrangement without cost, on thirty-three additional farms. In the latter studies the economic factors in soil fertility management are the chief items of investigation. Of the several major elements in soil fertility, phosphorus has received the greatest attention. This element also seems to be most deficient in Maryland soils especially where the available forms are concerned. The phosphorus studies have been the chief item in the extensive work done in base exchange. Although most of the work is aimed at the solution of farmers' problems, time has been found to do work in the nature of a contribution to the science itself. There has been developed a new method for the determination of potash which is cheaper and lends itself to greater facility in making these determinations. Contributions have been made in the separation and determination of the forms of phosphorus in the soil. Furthermore, much refinement has been given to the methods and technique of the quick tests used in determining the easily available elements in the soil. Other items having to do with methods at this Station are the Veitch lime requirement tests, and the salt bridge for determining solubility of salts. The Veitch method was one of the earliest lime requirement tests, and was used for many years by workers throughout the United States. In recent years soil biological work in the department has been productive of isolating the organism causing root rot in tobacco, and the determination of satisfactory methods of control. A larger understanding of the nature and disposition of organic matter in soils has resulted from projects in which the part played by micro-organisms was studied, and where the role of organic colloids in the base exchange was determined. In general, the program has been reasonably well balanced considering the number of persons on the staff and the funds available.

Much of the work in the Department has been conducted under funds available through the several Federal Acts appropriating money for state experiment station work. As far as possible these projects have been of the long-time type and basic in character. Frequently, it has been necessary to spend much time on the development of technique, but in general the results have been of greater importance than those obtained under the short-time problem system.

ANIMAL AND DAIRY HUSBANDRY

DEVÖE MEADE

Since the year 1888, when the University of Maryland Agricultural Experiment Station issued its first bulletin, four hundred and nine bulletins have been published. Of this number sixty-three, or over fifteen per cent, have been published by the Departments of Animal and Dairy Husbandry and relate directly to subjects pertaining to various phases of animal husbandry (not including poultry), dairy production, market milk and dairy manufacturing.

Fourteen other bulletins relating to animal diseases have been issued by the Station, making a total of twenty-seven, or approximately one-fifth of all Station bulletins, that deal with subjects of direct moment to the livestock and dairy industry.

In addition to these bulletins, well over one hundred relate to such subjects as cereals and forage crops; soils, fertilizers, and lime; grasses, hays and pastures; manures and manuring; and farm management and marketing, all of which pertain to subject matter having an intimate association with many phases of livestock and dairy husbandry.

As the College of Agriculture includes thirteen other subject-matter departments in addition to the Department of Animal and Dairy Husbandry, it is very evident that the latter department has carried on research and has published the results of its findings to an extent scarcely equalled by any other subject-matter group.

WORK COMPLETED DURING FISCAL YEAR, 1937-38

Bulletin 404, Dairy Herd Organization and Income on Dairy Farms, by DeVoe Meade, was published in September, 1936. The facts presented and the conclusions drawn are based on surveys records obtained on ninety representative dairy farms in five Maryland counties. This bulletin, consisting of thirteen pages, presents information respecting the organization of Maryland dairies and farms, and shows the relationship between profits realized and certain management and organization factors. The project "Organization, Operation, and Business Analysis of Livestock Farms in Maryland," carried on for two years jointly by this department with the Department of Agricultural Economics as a sub-project under General Project A-18, Organization and Business Analysis of Maryland Farms, is completed, preliminary report and summary being presented in the Forty-ninth Annual Report of the University of Maryland Agricultural Experiment Station. During the current year this work

has been summarized, analyzed, and has been published as Bulletin No. 406, *An Economic Study of Livestock Farms in Maryland*, by W. E. Bell, A. B. Hamilton, S. H. DeVault, and DeVoe Meade. This bulletin consists of forty-five pages. For a discussion of data, summary of results, and conclusions presented, reference to this bulletin is indicated.

A technical article entitled "To What Extent Do Tests From Composite Samples and Fresh Samples of Milk Agree," by DeVoe Meade and J. N. Leckie, was published in the *Milk Plant Monthly* for August, 1936, pages 28 to 30. This research was undertaken and the results published because of the very evident interest manifested in the degree of agreement between tests obtained from composite and from fresh samples of milk. The study extended over a time interval of six months and both composite and periodic-fresh samples were secured from milk delivered by nine patrons delivering milk to the University of Maryland Dairy. The test of regular ten-day composite samples was compared with the test of fresh milk samples taken on three days of each month at approximately equal intervals apart. The periodic fresh samples averaged 0.09 per cent higher than the average of the composite samples, 60 per cent of the composite samples testing lower than the fresh samples, 12 per cent the same, and 27 per cent higher. There was an average maximum range of 1.01 per cent butterfat in the fresh samples over the entire period, as compared with an 0.84 per cent range in the composites.

RESEARCH IN PROGRESS

Two research problems, although designated by no definite project numbers, are at present being investigated. The first of these is an ingredient-analysis of the open-formula livestock and dairy rations sold by the Grange League Federation and the Eastern States Farmers' Exchange, both of which are nationally prominent farmers' cooperative agencies. This study covers the years 1922 to 1937, and includes 352 formulas for feeds sold under fifteen different brand names. The results of this study will be concluded on or before January 1, 1938.

A second subject under investigation is a study to determine to what extent the daily production records of cows in the Station herd agree or disagree with records reported under the Herd Test plan. This study should be completed before June, 1938.

ANIMAL HUSBANDRY

B. E. CARMICHAEL

HAM PROJECT

Cooperative work on this project began in 1927 and has been concerned with studies in the production of hams of the general type known as "old Maryland" hams. In this work, hams from hogs produced at the University of Maryland have been used to some extent, as well as fresh hams secured from Baltimore packers. Chemical studies have been conducted, and the nature of some of the changes, among them the loss of moisture, the increase of free fatty acids (particularly in the meat fat, though also in the external fat), and an increase in total soluble nitrogen, have been determined. Bacteriological studies have been carried on and have shown that, coincident with the aging process, there is a reduction in the number of bacteria in the hams; no organisms believed to be responsible for the production of desirable ham flavors have been located.

In studies to secure data relative to the effect of heating upon the aging process, which, under farm conditions usually is permitted to proceed at ordinary smoke-house or other room temperatures, it was found that the application of heat hastened the aging process. A temperature of 42°C. (107.6°F.) has been found in these studies to be sufficiently high to hasten the curing process so that a ham with the characteristic flavor of a one-year-old ham aged in the usual way is developed in about eight to twelve weeks in the heated chamber. Lower temperatures are less efficient in hastening the aging process, while much higher temperatures cause excessive dripping losses and may even partially cook or char the hams. In the new aging process hams having fat that is of especially pleasing flavor are produced; losses due to evaporation are lower than when hams are aged for a long time at ordinary room temperature; and skipper damage is believed to be rendered impossible due to the fact that the temperature of 42°C. is too high to be tolerated by the skipper fly in its various stages.

Data secured in these studies have been included in Maryland Graduate School theses prepared by Dr. W. C. Supplee, by Dr. Daisy I. Purdy, and by Mr. Keith G. Acker; advanced reports covering the progress of the work have been presented at conferences of workers in cooperative quality-in-meat projects; Maryland Bulletin 350, by Dr. W. C. Supplee and Dr. L. B. Broughton entitled "Studies Relative to the Hydrolysis of the

Fat of Home-Cured Hams," has been published; and a bulletin manuscript summarizing the ham work is now partially written and soon should be ready for publication.

The new cooperative project agreement entered into on June 1, 1936, lists the following among the factors proposed for further study:

- (a) Effects of temperature and humidity control, air circulation, light, and time upon aging.
- (b) Effects of the injection of various curing and aging materials.
- (c) Effects of brine curing and dry curing.
- (d) Molds, rancidity, and skipper fly damage, and development of methods for their prevention.
- (e) Shrinkage during curing, aging, holding, and cooking.
- (f) Weight and fatness of cuts for farm curing and aging.
- (g) Holding cured meats which have been aged to the optimum degree, and development of methods for so doing.

It is expected that definite work dealing with a number of the factors listed will receive attention in the near future.

The following tentative plan, which has been discussed by representatives of this Department and of the U. S. Department of Agriculture, will perhaps need some revision, but is suggested as an appropriate plan to follow at first.

CURING SCHEDULE

For study of penetration, brine composition, change in fat, drying, etc.

Time in Cure	Dry Cure	Brine Cure	Injected Brine	Total No. of Hams
5 days	4 hams	4 hams	2 hams	10
15 days	4 hams	4 hams	2 hams	10
30 days	4 hams	4 hams	2 hams	10
45 days	4 hams	4 hams	2 hams	10
60 days	4 hams	4 hams	2 hams	10
Total	20 hams	20 hams	10 hams	50

AGING SCHEDULE

Approximate Temperature	Dry Cure	2° C. Brine Cure	Injected Brine	Dry Cure	22° C. Brine Cure	Injected Brine	Dry Cure	42° C. Brine Cure	Injected Brine
Time aged	Number of Hams								
6 weeks	2	2	2	2	2	2	2	2	2
8 weeks							2	2	2
10 weeks					2	2	2	2	2
12 weeks	2	2	2	2	2	2	2	2	2
26 weeks	2	2	2	2	2	2	4*	4*	4*
39 weeks	2	2	2	2	2	2	4*	4*	4*
52 weeks	2	2	2	2	2	2	4*	4*	4*
Total									126

*1 stored at 42°C.
 1 stored at 22°C.
 1 stored at 2°C.
 1 stored at -4°C. } after aging 12 weeks

Such bacteriological and chemical studies are recommended as may be needed to yield data concerning changes in the number, distribution, and kinds of bacteria at the different stages of the hams' development subsequent to slaughter, and concerning the changes in amounts and distribution of moisture and salt during the aging process. Studies are recommended concerning methods of storing good aged hams that would permit their desirable characteristics to be retained until needed.

Before this study is concluded, it is recommended that facilities be provided for curing at one time one hundred or more hams and aging them with the method that seems most likely to yield desirable hams. After aging, it is recommended that these hams be examined carefully on the basis of flavor by a number of experienced persons so as to get definite opinions as to the desirability of each of the hams from the standpoint of the appreciative consumer of old hams. The purpose of this would be to establish facts concerning the practicability of the method developed for producing good aged hams.

COOPERATIVE FEEDING TRIALS ON MARYLAND FARMS

FISHMEAL AND LINSEED OILMEAL COMPARED

Cooperative feeding trials have been conducted at two farms in Maryland. In a cattle feeding trial at Cremona Farms, St. Mary's County in which 50 steers were fed for 252 days, fishmeal and linseed oil meal were compared for use in dry-lot in connection with corn, barley, and soybean hay, and corn stover

showed but little differences—only about 1 per cent—in either rate of gain or feed required per unit of gains yielded by the two lots.

GROUND AND DAMAGED RYE COMPARED FOR FATTENING HOGS

In a cooperative hog-feeding trial conducted on the farm of Mr. H. S. Hutton, Montgomery County, whole and ground damaged rye were compared for use on second crop clover pasture. In this trial a rather high feed requirement per unit of gain was shown by both lots. A higher rate of gain resulted from the ground rye, 1.38 lbs. daily per pig as compared with 1.2 lbs., or 15 per cent higher, and the feed requirement per pound of gain was about $1\frac{1}{3}$ per cent higher for the ground rye lot, 4.79 lbs. as compared with 4.72 lbs. for the lots fed ground and whole damaged rye, respectively.

COOPERATIVE SHEEP WORK. EARLY LAMB PRODUCTION

WITH STABLER BROS., MONTGOMERY COUNTY

Approximately 25 of the University's crossbred Dorset X Merino ewes which were used in the cooperative experimental work at the farm operated by Stabler Bros. in Montgomery County, reported in Bulletin 398, pages 49 to 56, have been left there on a share basis, the University to receive one-fourth of the returns from the wool and from the lambs. Records are being kept concerning the dates on which the lambs are dropped; date of sale of lambs; approximate or exact sale weight of lambs; prices for which lambs are sold; and individual wool yields for the different ewes. Birth weights of lambs have been recorded for a part of the time these ewes have been at Stabler Bros. farm.

Facilities for conducting a definite production experiment are not available, but the data referred to in the foregoing should be of value. In view of the fact that the University now has more of facilities for handling sheep than were available when this work was undertaken, it is recommended that this cooperative work be discontinued by sale of the ewes or by bringing them back to the University, unless it is deemed desirable to continue the observations during the productive life time of the ewes, in which event the data to be gathered should justify that course—especially since its continuation would involve no cash outlay to the University.

BACTERIOLOGY

L. H. JAMES

The Department of Bacteriology and Animal Pathology, having no active research projects, has been largely a service organization, cooperating with the Biological Laboratory and Livestock Sanitary Service.

A total of 1620 cubic centimeters of hog cholera virus, and 379,225 cc. of anti-hog cholera serum were furnished to residents of the state at cost. Considerable tuberculin was also distributed, namely 21,412 cc.

Bacterial inoculum for leguminous plants is also prepared and mailed from this department.

Inoculum for approximately 4,000 bushels of seed was distributed during the year.

Certain other services have customarily been offered by this Department, particularly in the analyses of water and milk samples. Since such analysis should be made at the State Department of Health, this work is not encouraged. During the past year 214 water samples and 328 milk samples were examined.

PLANT PATHOLOGY

SUMMARY OF ACCOMPLISHMENTS

C. E. TEMPLE

A. Wilt-Resistant Tomatoes. The investigations of the wilt disease of tomatoes by Professor Norton in 1912 and later, followed by the distribution of the seed of his wilt-resistant varieties to 2600 people in the state in a single year by the writer, paved the way for the use of other wilt-resistant varieties. These new varieties now make up nearly all of the tomato acreage of the state.

B. Wilt-Resistant Peas. The breeding and selecting of peas for resistance to diseases by the Maryland Experiment Station has resulted in the use of three wilt-resistant varieties known in the trade as Asgrow Alaska No. 5, Superlaska, and Maryland Alaska. According to reports of seedsmen, more than 5,000 acres of these varieties were grown for seed in the West in 1936; and according to Mr. H. A. Hunter, Canning Crops Specialist of the Maryland Agricultural Extension Service, more than fifty per cent of the pea seed planted in Maryland this year for canning purposes was of these three varieties. Since these varieties are resistant to wilt and are desirable in other ways, they are being used also in other states.

C. *Quality of Pea Seed Stocks Improved.* The continuous program with peas in the state should be given credit for the general improvement of the pea seed stocks delivered by the seedsmen to the canners. When the investigations were begun in 1918 Maryland was a dumping ground for low-grade pea seed. Mixed varieties and diseased stocks were common then but now they are rarely seen.

D. *Rotation.* When the investigations of the diseases of peas was begun it was common practice to plant peas in the same land until the crop failed. Fields that had been planted to peas for five to seven years in succession were found. It was this practice that made the conditions calling for the original investigations of the diseases of peas in Maryland. The farmers and canners realize now the importance of growing other crops between pea crops and a good system of crop rotation has been adopted generally.

PLANT PHYSIOLOGY

FROM ITS ORGANIZATION TO THE PRESENT

C. O. APPLEMAN

The Plant Physiology laboratory of the Experiment Station started in 1910 and the writer has been in charge of this laboratory from the beginning. He has had associated with him for varying periods of time both full time and part time assistants. Most of the part time assistants were candidates for higher degrees.

The physical and biochemical aspect of the conservation of plant food products has been an important field of research extending over a number of years. This project has involved extensive studies of "after harvest" physiology in a large number of vegetables and cereals. The work on sweet corn, tomatoes and peas has been of considerable importance to the canning industry.

Much of the earlier work was concerned with the mineral nutrition of selected plant crops. Many of the problems of mineral nutrition can be solved only by the carefully controlled water and sand culture methods of the plant physiologist. By these methods our knowledge of the essential role of some of the rare elements was extended. This was particularly true of boron. Symptoms resulting from a deficiency of each of the various essential mineral elements were studied and described.

Extensive studies of the physiology of cold and drought hardness in peach buds and in foreign and domestic red clovers brought results of both scientific and practical value.

The discovery of growth regulators or hormone-like substances has opened up a new field of research in plant physiology. Studies in this field are shedding light on many obscure problems in plant growth and development.

The following are some of the more important additional problems which have been investigated and the results have been sufficiently conclusive to warrant one or more publications in each investigation:

The rest period in potato tubers; aerobic and anaerobic respiration in plant organs with special reference to their storage and transportation; relation of catalase and oxidase to respiration in plants; the physiological basis for the preparation of potatoes for seed; apical dominance in potatoes as an index to seed value; ripening processes in tomatoes, potatoes, sweet corn, etc., and the evaluation of climatic temperature efficiency for these processes; biochemistry of the pectic substances in plants and the relation of these substances to the softening of the fruit and to the quality of canned tomatoes; catalase activity and its relation to plant metabolism; nitrogen metabolism and its relation to important plant responses; physiological studies in the pathogenicity of *Fusarium lycopersici* for the tomato plant; unfreezable and freezable water in plant tissues; physical and chemical properties of soluble polysaccharides in sweet corn; physical and biochemical methods.

There has been a total of seventy research publications from the laboratory of plant physiology since its organization. Of these, twenty-three have been bulletin publications and forty-nine have appeared in scientific journals. The following is a list of the journals that have received these publications and the number of papers published by each journal:

Plant Physiology	11
Journal of Agricultural Research.....	8
American Journal of Botany.....	5
Science	5
Botanical Gazette	4
Soil Science	4
Journal of Chemical Education.....	2
Journal of the American Chemical Society.....	2

ENTOMOLOGY

ACCOMPLISHMENTS OF RESEARCH PROGRAM

E. N. CORY

This department has given attention to those projects for which growers have demanded work to meet problems of infestations on their crops and animals, and to those problems involv-

ing human welfare. It is difficult to summarize a research program that has been running under its present direction since 1914, except to say that the outstanding problems have been met so that farmers could continue to grow crops with a minimum of loss.

Farmers who have used methods developed in this department have in many instances saved large sums, notably in the case of the codling moth and curculio, and the program for strawberry dusting. Nurserymen and greenhouse men have profited by following methods of control developed in this department, in many cases saving entire crops or protecting nursery stock. Cannerymen who have followed the washing set-up advocated in the control of the vinegar gnat have been free from seizures after the first year, when seizures brought about the study of this problem. Cattlemen and horsemen who have followed the dusting recommendations of this department have relieved their animals of lice infestation. Home owners have followed directions from this department in connection with termite and powder post beetle treatment to their advantage.

In addition to research relative to the control of insects, a number of valuable contributions have been made in morphology, ecology and physiology as a result of investigations along these lines.

ENTOMOLOGY, A FUNDAMENTAL SCIENCE

1. Entomology is one of the broadest scientific subjects with which man has to deal. There are approximately 150,000 more known species of insects than all other biological species. Excluding insects, there are only 215,000 species of animals and about 250,000 species of plants. There are 625,000 species of described insects.

2. Entomology is unique in that it is a subject that no man, regardless of position, can go through life without contacting directly. A man may go through life without desire or a consciousness for information on how to grow a potato, build a house, or many of the fundamentals of life, but sooner or later he comes in direct contact with an insect and wants to know where it came from and how to get rid of it.

3. Entomology has affinities with the humanities, social sciences, physical sciences and biological sciences. The history of entire nations has been altered by insects.

4. The scope of the subject and the fundamentals involved make for entomology a dominant place in any scientific educational set up. Through need, the people of America have given

t a place of distinction among the leading sciences. Of all the affiliated scientific organizations in the American Association for the Advancement of Science, the Entomological organization is the largest and strongest.

5. If this University hopes to maintain its prestige in the field of entomology and hopes to train young people for positions in the science of entomology, and adequately serve the public, a department of entomology must be maintained and administered by a practical entomologist who knows both the fundamentals and wants and needs of the public.

6. Its attachment to horticulture, agronomy or animal husbandry would be unwise and basically unsound. In the end it would be confusing to the public, expensive, and lower the scientific standards of the institution.

7. Entomology as a profession includes broad fundamental subjects which do not fit easily into other subject matter. These subjects are essential to the training of a well equipped research entomologist.

1. Insect taxonomy
2. Insect morphology
3. Insect physiology
4. Insect ecology
5. Insect biology
6. Insect toxicology
7. Applied entomology

8. Entomologists realize that specialists in other fields untrained in, and without knowledge of the fundamentals of entomology, sometime attempt to convince executives that entomology is a part of their comparatively narrow fields. This erroneous idea is always arrived at by the fact that in the specialist's chosen field there are a few insects which cause him major concern and he feels that these cover for the most part the field of entomology.

9. Excluding all the fundamentals essential to scientific entomology and the training of entomologists, statistics are appended showing the insect pests commonly encountered in several fields of science. The pests considered in these figures are not unusual, but the common ones on which information from this office is requested year after year, nor does the list cover anything like the total number of insects in the several groups.

Also there is appended a statement showing the many ways in which the subject of applied entomology, as it relates to control only, has common ground with other subjects.

Statistics of the most common insect pests encountered in several fields of science on which the Maryland Entomology Department gives control information, year after year.

(Fundamentals, special problems and outbreaks excluded).

Science	No. Common Insect Pests
Agronomy	
Cereal and forage crops.....	53
Horticulture	
Truck crops	20
Deciduous fruits.....	19
Ornamentals	24
Forestry	5
Home Economics	
Household insects	24
Animal Industry	
Annoying and injurious insects.....	17
Sociology	
Insects annoying man.....	20
Engineering	
Insects of structural timbers.....	2
Medicine	
Vectors of diseases.....	3
Plant Pathology	
Vectors of plant diseases.....	3
Law	
Quarantine, etc.....	52*

*The states in the Union have over 200 different quarantines on 52 insects. In addition to furnishing information on these quarantines the Department of Entomology must furnish information on 48 different state laws regarding insects, know the 70 odd Federal quarantines and give information on regulations enforced by all foreign countries.

Applied Entomology in Maryland as it Relates to Several Sciences
(Entomological Fundamentals excluded).

1. Chemistry.....	Insecticides
2. Engineering.....	Machinery
	Physical control
	Mechanical control
3. Agronomy.....	Cultural practices
	Fertilization
	Crop rotation.
4. Genetics.....	Resistant plants
5. Pharmacy.....	Toxicology
6. Medicine.....	Biology and control of
	vectors of diseases
7. Zoology.....	Biological control
	Parasites and predators
8. Botany.....	Host relations and
	preferences
9. Plant Pathology.....	Biological control by
	fungi
10. Bacteriology.....	Biological control
11. Home Economics.....	Home and institutional
	management and practices.
12. Law.....	Legislative control

HORTICULTURE

A. L. SCHRADER

Since the inception of the research work in horticulture in Maryland, there has been an ever-increasing demand to solve problems of the fruit grower, vegetable grower, canner, florist, and nurseryman. As a natural result a large number of projects have been formulated, many of them now completed, which have rendered worth-while results of practical value to the horticultural industries as well as to the distributor and consumer of the products. Many of the projects have led into the fundamental aspects of biological research and facts of scientific worth have accumulated for use in teaching and further research. The types of investigations have included work on variety trials, breeding and selection of better varieties, pollination of fruits, vegetables and flowers, fertilizer effects on the growth and fruiting of horticultural plants in the field and greenhouse, pruning of various trees and plants in relation to plant responses, thinning of fruits, cultural methods in field and greenhouse production, propagation of the various plants, storage behavior of fruits and vegetables, quality of edible fruits and vegetables, spray residue removal, and spray injury of fruits. During the past fifty years a total of 172 research projects have been formulated and actively pursued. Seventy-five regular station bulletins have been published, giving results of definite value and interest. In addition to the station bulletins, 114 articles in journals have included further results, adding to our horticultural knowledge.

Considering some of the outstanding findings of the research program, it might first be pointed out that hundreds of varieties of fruits, vegetables, and flowers have been carefully studied in trial plantings to determine the adaptability and commercial value of new varieties, thus preventing the waste of money and time of growers on worthless varieties or assisting in the introduction of better varieties.

In the work with fruits, pruning of grapes and peaches has received special attention. The four-cane Kniffin system of training grapes has been found superior to other methods for Maryland conditions. In the pruning of the young grape vine, it was found possible to bring the Concord variety into full production in the third season after planting, one year earlier than is accomplished with the usual method. In the selection of the fruiting wood of the Concord grape at pruning time, the most fruitful type of cane proved to be a six to eight foot length before pruning, with a diameter of pencil-size. With peach trees, a light pruning of young trees instead of the severe pruning usually

practiced produced marked advantages in earlier productive age and more fruit. A new system of training the scaffold limb development by shoot removal on the young tree in the first season resulted in a much stronger tree. Commercial rejuvenation of old peach trees was found possible by a moderate dehorning of the scaffold limbs in preference to the heavy dehorning often tried with indifferent success.

With extension fertilizer studies on fruits, nitrogen fertilizers have proved of great value through increasing the growth and fruiting of fruit trees over the state, and fall applications have been shown especially desirable, as compared with spring applications, notably with certain of the materials. Spreading the fertilizer under the outer spread of branches was preferable to a more concentrated band closer to the trunk of the tree.

As a result of fertilizer studies with the strawberry, the fertilizer practice has been modified to avoid some bad effects of spring applications before the fruiting of the beds.

By means of storage and shipping tests, it was found that fertilizers had no direct effect on the shipping and keeping qualities of peaches, apples, or strawberries, except as larger fruits, which might be produced, would be inferior in these respects.

In attempts to influence quality of fruits, thinning of fruits has had marked value in increasing the size, color, and edible quality. Soil moisture and tree leaf area determine the development of red color of apples to a large degree. Light is another essential, particularly the blue end of the spectrum with the near ultra-violet and ultra violet as necessary to color formation. With the strawberry, plant spacing in the beds by removal of excess runner plants has increased size and quality of the berries and greatly increased the yield of varieties that are prolific plant makers.

Breeding of grapes, apples, pears, and peaches has produced some promising seedlings, none of which has been introduced as yet.

Extensive pollination studies with fruits have yielded results in the determination of proper pollenizers for our varieties, which has greatly increased the yields of orchards, some of which were not fruitful until this work was done.

Studies on the physiology of fruit trees have shown that nitrogen in fertilizers applied in the fall of the year is taken into the roots and stored in the larger roots until growth of the top of the tree starts in the following spring. Nitrogen applied in early spring is taken up quickly by the roots and translocated to the tree parts within two or three weeks as shown by chemical analyses of spurs. Shading of an apple tree, reducing the light

considerably below normal, inhibits flower bud formation which is correlated with effects on the carbohydrate and nitrogen metabolism of the spurs and twigs. Root distribution and type in the orchard and in the nursery indicate that great advances can be made by such studies, both from a practical and scientific viewpoint.

In the field of work with vegetables, a noteworthy achievement has been made in the recent introduction of Maryland Golden Sweet, a new sweet potato of great merit, now grown in great acreage and in great demand. A winter-hardy spinach, recently introduced as Maryland Savoy, meets an often repeated request for a variety that will not winter kill.

In the culture of vegetable crops for market and canning, many improvements have been made in practices as a result of detailed field studies. Early planting of peas has been found to give best yields and best quality. Late planted peas mature more rapidly and thus timely harvesting to get canning quality is more difficult. In work on rate of seeding, four bushels of pea seed per acre resulted in the greatest yield. Spring plowing for pea production proved to be preferable. Soil fertility appears to be the most important factor governing pea production. Rhubarb responded best to sulphate of ammonia, as a source of nitrogen. Fertilizer applications high in potash and low in nitrogen are shown to be important in sweet potato production. In sweet corn production for canning, high fertility of soil resulted in more rapid maturity and hence restricted harvest season. In determining the effect of soil fertility on tomatoes, yield and canning quality were increased by high soil fertility. Chemical analyses showed that nitrogen and potassium increased in such tomatoes, but not phosphorus. In studies on tomato cracking, variety characteristics were found as to types of cracking. Close planting and development of foliage to shade the fruits was found important, as a means to lessen cracking. Soil moisture variations and evaporating power of the air are other important factors in relation to cracking.

Development of edible quality in parsnips proved to be determined by low temperatures and hence cold storage can be used to advantage on this crop.

With flowers and ornamental plants work has not been extensive. Double stocks have been produced by selection. Rose pruning can be less severe under greenhouse conditions to increase yield. The forcing of gladiolus in winter can be accomplished earlier by summer storage.

SEED INSPECTION

THE VALUE OF THE SEEDS PLANTED ANNUALLY
IN MARYLAND

F. S. HOLMES

The value of the seeds planted annually in Maryland is estimated to be \$2,500,000. This figure was arrived at by calculating the value of the seed planted for each of the principal crops grown in the state and by adding to these major items certain miscellaneous ones, such, for example, as the seeds used for home vegetable gardens. Acreages and retail seed prices for the period from 1931 to 1935 were used in making the calculations. As both were lower during this period than in other recent years, the estimate of \$2,500,000 is believed to be a very conservative one. The total value of the seeds planted in the state will vary considerably from year to year, and the value of a particular kind of seed may vary widely from year to year.

In view of the fact that no further estimate of the value of the seeds planted annually in Maryland is known, the reasonableness of the estimate of \$2,500,000, as determined by calculating the value of the seed planted for each principal crop, should be tested by approaching the problem from other angles. One such approach is to be found in the estimate of the worth of the seeds required to produce the crops harvested annually in the United States made by Cox and Starr in their book, *Seed Production and Marketing*, published in 1927. They estimate these seeds to be worth "over \$500,000,000." The Agricultural Census of 1935 gives the number of acres of land available for crops in 1934 for the United States as 513,913,969, and for Maryland as 2,633,113. On such a proportional basis, the worth of the seeds planted annually in Maryland would be "over \$2,561,823.76." Another test of the reasonableness of the estimate of \$2,500,000 is to be found in the amount that such a sum would allow for each farm. According to the last agricultural census, there are 44,412 farms, averaging 98.7 acres in size, in Maryland. The estimate, therefore, would allow for \$56.29 per farm. Still another test of the reasonableness of the estimate is to apportion it among the 2,633,113 acres of land available for crops. Slightly less than a dollar per acre would be provided by the sum of \$2,500,000.

The value of the "agricultural" seeds planted annually in Maryland, including such miscellaneous items as seeds for lawns, is estimated to be \$2,000,000; the value of the "vegetable" seeds, \$500,000. Figures for particular crops, even though calculated from reported acreages and quoted prices, are not as accurate

as their total because the errors for seeds of different crops cancel each other to a considerable extent if not altogether.

While not to be taken too literally, approximate figures for the principal crops are given in round numbers. These figures give an idea of the relative values of the seeds used for the principal crops of Maryland. The value of the seed planted for a given crop is affected by several factors. Among these are the acreage planted, the amount of seed required per acre, and the price of the seed per pound. For some crops, wheat being an example, the value of the seed is a considerable item in the total cost of producing the crop. For other crops, tobacco being an example, the value of the seed is a negligible item. A crop of wheat may be worth twenty times the value of the seed; a crop of tobacco may be worth a thousand times the value of the seed.

The approximate values of the seeds planted annually for the production of the principal crops of Maryland are estimated to be as follows:

Wheat	\$800,000
Red clover.....	320,000
Timothy	180,000
Field corn.....	160,000
Barley	80,000
Oats	80,000
Soybeans	80,000
Rye	75,000
Alfalfa	50,000
Golf courses, lawns, nurseries, roadsides, etc.....	50,000
Alsike clover	30,000
Miscellaneous farm crops.....	30,000
Cowpeas	25,000
Buckwheat	10,000
Lespedeza	10,000
Crimson clover	8,000
Sweet clover	8,000
Tobacco	4,000
Peas	120,000
Home vegetable gardens.....	100,000
Snap beans.....	100,000
Miscellaneous truck crops.....	50,000
Tomatoes	40,000
Lima beans.....	30,000
Cantaloupes	20,000
Sweet corn	20,000
Spinach	8,000
Cucumbers	6,000
Watermelons	5,000
Cabbage	1,000

Prices of seeds fluctuate from year to year, and acreages of particular crops may change rapidly. The substitution of one crop for another may bring about little change in the total value of the seeds planted. The acreage of all crops will not fluctuate as widely as will the average prices of seeds. The total value of the seeds planted will be more stable than either acreage or prices.

Red Clover:

Red clover is the most important legume grown in Maryland. It is used chiefly in Maryland as a hay, forage crop and soil improver, but it also has a highly important place as a seed crop.

With the exception of Idaho, the production of Maryland clover seed per unit acre of land available for crops is higher in Maryland than in any other state. The interest in home grown clover seed in Maryland is increasing because it is more certain to produce a crop. Recent prices have also stimulated the interest in Maryland grown seed.

The samples inspected during the past year gave the following results:

AVERAGES OF 195 MARYLAND RED CLOVER SEED SAMPLES SUBMITTED TO THE STATE SEED LABORATORY BETWEEN APRIL 1, 1936, AND MARCH 31, 1937

Pure seed	92.89
Weed seeds	5.46
Germination	79.86
Hard seed	10.81

AVERAGES OF SAMPLES OF RED CLOVER SEED BY AREAS

Western Shore (131 Samples)		Eastern Shore (64 Samples)	
Pure seed	93.43	Pure seed	91.78
Weed seeds	4.76	Weed seeds	6.90
Germination	79.11	Germination	81.41
Hard seed	11.85	Hard seed	8.69

The two commonly occurring noxious weeds are chicory and dodder. Chicory occurs in greater quantities among samples from the Western Shore while dodder is more prevalent in seed originating on the Eastern Shore.

Buckhorn is the most common occurring weed in red clover. However, it may be removed with little difficulty. Black seed plantain occurs commonly all over the state yet to a lesser extent than buckhorn. It, too, may be easily removed. Wild carrot seed occurs, it seems, to a much greater extent in Harford, Baltimore Carroll, Frederick, and Washington County samples than from other parts of the state. Although these are the most common weed seeds occurring in Maryland red clover, there are many of minor importance. The minor weeds are: field cress, dock (curled and broad leaf), sorrel, trefoil, green foxtail, hoary

vervain, bracted plantain, lambs quarter, field camomile, and slender paspalum.

Hard seed deserves some comment. They have some value perhaps, yet we hesitate to say for they may germinate eventually or they may not.

We can not draw conclusions from records on tests of such a short period. However, we may say that these figures are comparable to long period averages and they do imply quality in our home-grown red clover seed.

FINANCES

RESOURCES, RECEIPTS AND EXPENDITURES

The Experiment Station work is maintained chiefly by State and Federal appropriations.

The State appropriations are used largely for maintenance, new equipment, executive expenses, and to supplement the Federal allotments. The Federal appropriations are made under the provisions of the laws known as the Hatch, Adams, Purnell, and Bankhead-Jones Acts. These acts outline the nature and kinds of research to be conducted, and make some restrictions as to the expenditures. The Bankhead-Jones Act appropriation is determined by the rural population of the State. This act requires the State to provide and expend at least an equal sum each year for agricultural research. The following financial statement gives the details as to the receipts and expenditures for the fiscal year covered by this report:

MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH
UNITED STATES APPROPRIATIONS

DR.	Hatch Fund	Adams Fund	Purnell Fund	Bankhead Jones Fun
To appropriations for Fiscal year 1936-37	\$15,000.00	\$15,000.00	\$60,000.00	\$14,275.
CR.				
By Salaries	\$14,018.91	\$12,716.36	\$46,139.49	\$10,518.
Labor	656.80	986.60	3,811.01	904.
Stationery and Office Sup- plies	36.00		161.41	10.
Scientific Supplies		262.48	1,484.52	485.
Feeding Stuffs	53.46		583.61	
Sundry Supplies		318.27	585.78	224.
Fertilizers	55.56		382.05	45.
Communication Service	4.99	15.49	181.98	1.
Travel	100.52	88.34	2,781.36	879.
Transportation of Things .....			.50	
Publications			1,479.50	361.
Heat, Light, Water and Power	7.76	34.39		
Furniture, Furnishings and Fixtures	66.00		132.68	76.
Library			4.50	12.
Scientific Equipment		578.07	751.22	552.
Tools, Machinery and Ap- pliances			810.54	20.
Repairs			117.87	2.
Live Stock			550.10	
Buildings and Land			33.09	175.
Contingent			8.70	6.
Totals	\$15,000.00	\$15,000.00	\$60,000.00	\$14,275.

MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH THE STATE FUNDS

DR.	Research Fund	Ridgely Farm	Biological Laboratory	Seed Inspection
Balance June 30, 1936.....	\$ 7,229.19	\$ 837.07	\$ 1,769.31	\$ 1,439.54
Receipts for year 1936-37.....	40,179.00	2,802.25	9,237.23	6,076.00
Totals	<u>\$47,408.19</u>	<u>\$ 3,639.32</u>	<u>\$11,006.54</u>	<u>\$ 7,515.54</u>
CR.				
Salaries	\$15,631.13	\$ 1,500.00	\$ 3,447.33	\$ 5,667.10
Labor	10,906.40	1,076.65	1,946.32	4.58
Stationery and Office Sup- plies	38.26		89.36	54.90
Scientific Supplies	530.21		222.32	60.18
Feeding Stuffs	4,351.63	55.45		
Sundry Supplies	427.74	98.94	2,432.43	7.34
Fertilizer	1,030.16	81.01		
Communication Service	392.36	35.05	198.32	129.55
Travel Expense	378.17			
Transportation of Things	405.94	1.83	216.19	
Publications	692.46			
Heat, Light, Water and Power	763.40	4.38	630.53	
Furniture and Furnishings, Etc.	27.93			94.70
Library	166.21			5.00
Scientific Equipment	296.76		10.80	27.10
Livestock	50.00		44.50	
Tools, Machinery and Ap- pliances	532.59	150.00		15.40
Buildings and Land	1,668.22		61.15	3.62
Contingent	1,439.26	1.10	101.99	10.00
Totals	<u>\$39,728.83</u>	<u>\$3,004.41</u>	<u>\$ 9,401.24</u>	<u>\$6,079.47</u>
Credit Balance June 30, 1937	7,679.36	634.91	1,605.30	1,436.07
Totals	<u>\$47,408.19</u>	<u>\$3,639.32</u>	<u>\$11,006.54</u>	<u>\$7,515.54</u>

MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH RECEIPT FUNDS

DR.	Station Farm	Otten Farm	Dairy Inspec- tion Service
Balance June 30, 1936.....	\$ 2,568.19	\$1,982.84	\$1,169.83
Receipts for year 1936-37.....	21,893.81	.....	2,484.18
Totals	\$24,462.00	\$1,982.84	\$3,654.01
CR.			
By Salaries	\$ 750.01	.....	\$1,450.03
Labor	10,864.21	\$ 518.49	130.31
Stationery and Office Supplies.....	24.39	.....	30.61
Scientific Supplies	156.98	.....	5.47
Feeding Stuffs	6,658.34	.....	.....
Sundry Supplies	1,773.78	104.99	.....
Fertilizer	287.39	84.96	.....
Communication Service	24.91	37.05	60.00
Travel Expense	1,258.17	39.04	924.08
Transportation of Things.....	1,054.72	1.54	1.19
Publications .....	.....	.....	59.76
Heat, Light, Power and Water.....	538.76	.....	.....
Furniture, Furnishings and Fix- tures .....	.....	.....	.....
Library	29.92	.....	.....
Scientific Equipment	6.19	.....	.....
Livestock	102.13	1,125.00	.....
Tools, Machinery and Appliances	1,300.80	68.86	.....
Buildings and Land.....	1,342.31	.....	.....
Contingent	221.36	.....	.....
Totals	\$26,394.37	\$1,979.93	\$2,671.45
Balance June 30, 1937	—1,932.37	2.91	982.56
Totals	\$24,462.00	\$1,982.84	\$3,654.01

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MISSISSAUGA, ONTARIO
CITY OF MISSISSAUGA
COUNCIL CHAMBERS

DO NOT CIRCULATE

DO ~~SECRET~~ CIRCULATE

